

It will be observed that the diagrams of the separate words, although they become modified when grouped together, are more or less discernible in the lines continuously spoken; and the similarity of sound at the termination of the first three lines, which constitutes the rhyme of the verse, is represented in the similarity of form, or in the character of the form, of the terminations of the diagrams of these three lines.

The subject might be pursued much further by showing the diagrams of the same words spoken by different individuals, the outlines produced by the words and sentences of other languages, the effect produced by change of accent, &c.

My object, however, has not been to pursue the subject into minute detail, but to show that the articulation of the human voice is accompanied by definite pneumatic actions, and that those actions, many of which are insensible to ordinary observation, are capable of being recorded.

II. "Note on the Periodicity of Rainfall." By J. H. N. HENNESSEY, Esq., F.R.A.S. Communicated by Prof. G. G. STOKES, Sec.R.S. Received February 24, 1874.

1. Interested in the inquiry proposed by Mr. Meldrum, as to whether rainfall varies with the sun-spot area, I examined the register kept at the office of the Superintendent of the Great Trigonometrical Survey of India, and am enabled, through the courtesy of Colonel J. T. Walker, R.E., to communicate the results. These are probably not devoid of peculiar interest, from the abnormal conditions presented by the stations of observation, which are far inland, and on, or adjoining, lofty mountains, as appears from the following brief descriptions.

2. Mussoorie station is on the southernmost range of the Himalaya Mountains, lat. N. $30^{\circ} 28'$, long. E. $78^{\circ} 7'$, height 6500 feet; this range rises suddenly and forms the northern boundary of the Dehra Doon (or Dehra valley), which is some 18 miles wide and 40 miles long, and is bounded to the south by the Sewalik range of hills, about 3500 feet high. Dehra station is 2200 feet high, 10 miles south of Mussoorie station, and in the Dehra valley.

3. Owing to the absence of the observers in the winter months from Mussoorie station, the rainfall is not recorded there during that period; this, however, is of little consequence to the inquiry in hand, for the total annual fall occurs almost entirely in June, July, and August. I accordingly give in Table I. the total fall at Mussoorie between May 1 and October 31 of each year; and in order to make these totals comparable at the two stations, if desired, the fall for January, February, March, April, November, and December is excluded from the Dehra totals; this quantity excluded may be set down at some 6 inches, or only

some $7\frac{1}{2}$ per cent. of the *annual* fall. Excepting five years at Dehra and two at Mussoorie, all the observations have been taken under my own superintendence, so that I can vouch for their accuracy. Rejecting decimal places as redundant, the rainfall is as follows (in inches) for 20 years at Mussoorie and for 13 years at Dehra :—

TABLE I.

Sun-spot area*.	Year (May 1 to Oct. 31).	Rainfall, in inches, at	
		Mussoorie station.	Dehra station.
	1854	101	
	1855	86	
Minimum	1856	93	
	1857	88	
	1858	85	
	1859	78	
Maximum	1860	66	
	1861	141	103
	1862	94†	110
	1863	93†	77†
	1864	82	72
	1865	76	67
	1866	81	75†
Minimum	1867	82	70
	1868	61	45
	1869	52	65
	1870	80	84
Maximum (?)	1871	84	114
	1872	83	83
	1873	82	63

4. Adding to the fall in the epochal year (*i. e.* maximum or minimum) the fall for one preceding and one succeeding year, we shall get what may be termed *three-year sums*; similarly, by including two years on each side of the epochal year, we find *five-year sums*‡: the results are as follows :—

TABLE II.

	3-year sums, in inches.		5-year sums, in inches.	
	Mussoorie.	Dehra.	Mussoorie.	Dehra.
1856. Minimum.....	267		453	
1860. Maximum	285		464	
1867. Minimum.....	224	190	352	322
1871. Maximum	247	281	381	409

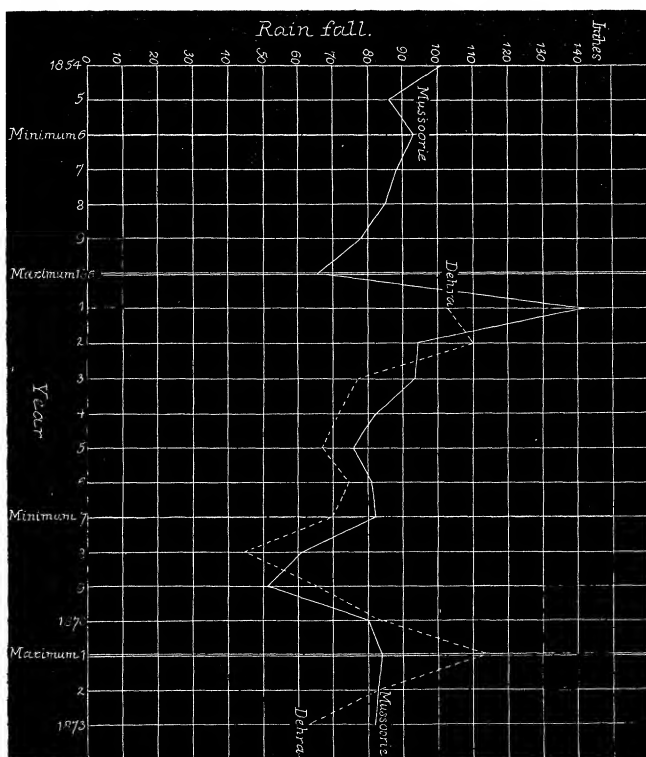
* Taken from a paper in 'Nature,' 1872, December 12, page 100, by Norman Lockyer, Esq., F.R.S., &c.

† Site of rain-gauge shifted.

‡ 'Nature,' 1872, December 12.

Notwithstanding the exceptional localities of the stations, the above results are generally in keeping with the Meldrum theory: the Dehra observations for 1860 and prior years are unfortunately wanting; but it will be seen in Table I. that heavy falls occurred in the two years succeeding the epochal year 1860.

5. It may, however, be questioned whether stations inland *are* ineligible to test the theory under notice. No doubt far more rain falls on certain parts of the globe than on others, and Mussoorie and Dehra are included in the former: but a large rainfall is in fact a recommendation, presenting as it does a large measure of the periodicity in question; so that stations under this condition appear highly eligible unless the rainfall is subject to abnormal fluctuations, apart from the supposed influence of sun-spot area; indeed, were it practicable to measure the total rainfall on the whole globe, the total results would present the most effective argument for periodicity. Projecting the facts of Table I., with the help of ordinates and abscissæ we obtain the appended diagram, where I am unable to



introduce, in lieu of the year, numerical values of sun-spot areas from want of complete results, such as those obtained by Messrs. De La Rue,

Balfour Stewart, and Loewy. Recognizing the sun as the governor of our system and the source of terrestrial heat and light, it appears certain that at least some of the circumstances attending our globe are directly or indirectly the results of solar conditions, of which we can read but too few, and interpret still fewer rightly. In the present instance we see that, as in other curves, a certain rainfall maximum may be *less* than minima not immediately preceding or succeeding; and this alone suggests the desirability of comparison with actual magnitudes of sun-spot areas; but the introduction of this more accurate test would doubtless prove a waste of time, unless the approximate relation at present under view can be maintained.

III. "Studies on Biogenesis." By WILLIAM ROBERTS, M.D., Manchester. Communicated by HENRY E. ROSCOE, F.R.S.
Received March 3, 1874.

(Abstract.)

The object of the investigation is to inquire into the mode of origin of *Bacteria* and toruloid vegetations. The inquiry is divided into three sections.

SECTION I. *On the sterilization by heat of organic liquids and mixtures.*—When beef-tea or a decoction of turnip is boiled for a few minutes and afterwards preserved from extraneous contamination, it passes into a state of "permanent sterility."

This state is characterized by loss of power to *originate* organisms with conservation of the power of *nourishing and promoting the growth* of organisms.

All organic liquids and mixtures seem capable of being brought to this state by exposure to the heat of 212° F.; but the length of time during which exposure to this heat is necessary to induce sterilization varies greatly according to the nature of the materials. Ordinary infusions and decoctions were sterilized by boiling for five or ten minutes; but milk, chopped green vegetables in water, pieces of boiled egg in water, and other mixtures were not sterilized unless the heat was continued for twenty to forty minutes. Hay-infusion was sterilized, like other infusions, by boiling for a few minutes; but when the infusion was rendered alkaline with ammonia or liquor potassæ, it was not sterilized except after an exposure to the heat of boiling water for more than an hour. Sometimes it germinated after two hours, and once after three hours of such exposure.

There appeared to be two factors of equal importance in the induction of sterilization—namely, the *degree* of heat and the *duration* of its application. These two factors appeared to be mutually compensatory in such fashion that a longer exposure to a lower temperature was equivalent to

RAIN FALL.

